FOREST Management BULLETIN

THE NEED FOR PRECOMMERCIAL THINNING

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July 1973

Published by S. E. Area, State and Private Forestry — USDA Forest Service — 1720 Peachtree Rd., N.W. — Atlanta, Georgia 30309

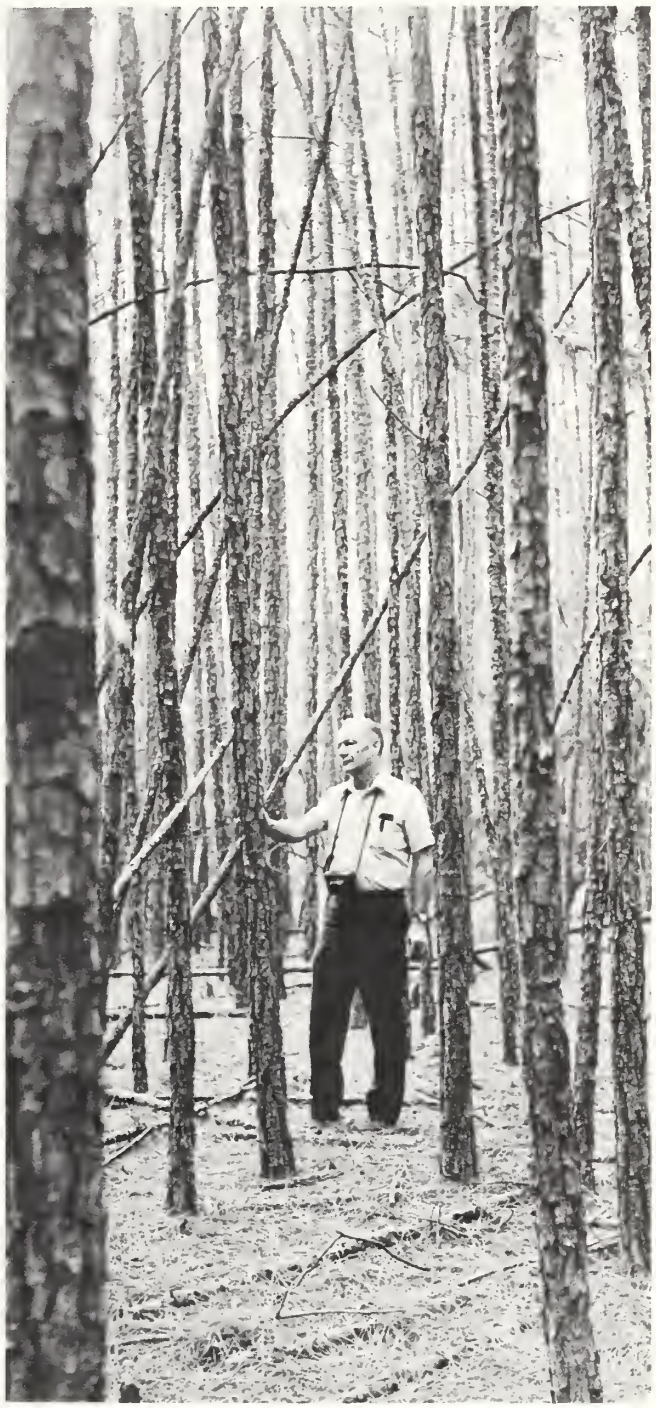
HERE'S THE PROBLEM

While much of the South's pineland acreage suffers from too little stocking per acre, many thousands of acres suffer from too much stocking. These include sites that were direct seeded with too many seed and those naturally reseeded either after a wildfire or after intensive site preparation. Stands of 50,000-plus stems per acre are not uncommon.

What to do? Both methods of reforestation—natural and direct-seeding—must remain in the forester's portfolio indefinitely, for they are the best means of regenerating many sites. In some cases, they are the only economic means. Even when superior seedlings are in adequate supply, some landowners will prefer natural and direct seeding because of lower establishment costs.

Will the crowded stands stagnate? If left intact, will crowded stands eventually grow to pulpwood and sawlog size in time to yield an economical return? Or should they be thinned, although it means money out of the pocket? If so, when is the time to bite the bullet? Not enough studies have been made to give all the final details, but decisions must be made today on the basis of what is known. The following report and recommendations are based upon the best information available at this time, particularly as it applies to the slash and loblolly species.

NOTE: These guidelines on precommercial thinning are the product of an interdisciplinary task force appointed by Southeastern Area, State and Private Forestry of the U.S. Forest Service. The task force made extensive use of forestry research findings, as well as observing operations in the field. Members of the task force, in addition to the leaders, were: Dr. Dan Speake of the Alabama Cooperative Wildlife Research Unit at Auburn University; L. V. Collicott, pine management project leader for International Paper Company's Southlands Experiment Forest; and Robert Jackson, fire specialist; Jerry Edwards, equipment development engineer; Dr. Ken Knauer, pest management specialist; and Ed. Kerr, writer, of the U. S. Forest Service. Mention of commercial products in this Bulletin is for information only and does not constitute endorsement by the U. S. Forest Service.



Unthinned Slash Stand. *This 23-year-old slash pine stand on the George Walton Experimental Forest near Cordele, Georgia initially contained 50,000 stems per acre.*

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WHAT DO WE KNOW?

Crowding Stunts Tree Growth

Two of the oldest studies of precommercial thinning are located at Crossett, Arkansas (loblolly) and Cordele, Georgia (slash). Both studies, which are approximately 20 years old, show a dramatic increase so far in diameter growth and pulpwood yield of thinned stands over unthinned checks.

The Crossett loblolly stand contained 25,300 pine stems per acre plus 7000 small hardwood stems. It was precommercially thinned at age seven by cutting 8-foot parallel swaths, leaving strips of pine trees three feet wide. In addition, all hardwoods four inches d.b.h. or larger were cut. Results are shown in Table 1. At age 19, after one commercial thinning on the stripped plots:

- Average d.b.h. was 25 percent higher than unthinned checks
- Total yield was 4.5 cords higher than unthinned checks
- Total yield was 112 percent higher than unthinned checks.

In addition to the mechanical thinning, some plots were hand thinned at the time of the original thinning and once afterward. All hardwoods were cut from these plots. At age 19:

- Average d.b.h. was more than twice that of unthinned checks
- Total yield was 11.6 cords per acre higher than unthinned checks
- Total yield was 290 percent higher than unthinned checks.

Table 1. Effects of Precommercial Thinning on Loblolly Pine After 12 Years*

(Stand Age: 19 Years)

Treatment	Trees per acre	Basal area per acre (sq. ft.)	Avg. d.b.h. (in.)	Avg. ht. dom. at age 21 (ft.)	Total merch. yield (cds.)
Strip plus hand	547	103	5.9	52	15.6
Strip only	1687	110	3.5	48	8.5
Unthinned check	2717	120	2.8	44	4.0

*From "Precommercial thinning of Loblolly Pine" by Charles X. Grano. Journal of Forestry 67: 825-827.

Table 2. Effects of Precommercial Thinning on Slash Pine After 14 Years*

(Stand Age: 17 Years)

Treatment	Trees per tree	Basal area per acre	Avg. d.b.h. (in.)	Avg. ht. dom. (ft.)	Total merch. yield (cds.)
Single tree	366	89	6.6	42	16.8
Clump	1450	104	3.8	38	9.9
Check	5762	167	2.4	32	1.5

*Data from Research Paper SE-27, Southeastern Forest Experiment Station, published in 1967.

By age 26 the stripped plots had been commercially thinned once and the hand thinned plots twice. A measurement of one plot for each treatment at that time indicated that total yields for the three treatments were 46 cords, 36 cords and 27 cords for the hand thinned, strip thinned and check plots respectively. Average diameter and height growth differences continue to spread. The unthinned plot still indicates a longer rotation and smaller products.

Thinned Slash Stand. *The result, after 20 years, of checkerboard thinning plus hand thinning, resulting in 10' by 10' spacing.*

The Cordele slash stand initially contained up to 50,000 stems per acre. It was precommercially thinned at age three by checkerboard stripping, leaving small clumps of trees on 10-foot centers. Results are shown in Table 2. After 14 years:

- Average d.b.h. was 58 percent higher than unthinned checks
- Total yield was 8.4 cords per acre higher than unthinned checks—almost six times greater

Some plots were thinned much more heavily, leaving only one seedling on 10-foot centers. On these plots:

- Average d.b.h. was nearly three times more than unthinned checks
- Total yield was 15.3 cords per acre higher than unthinned checks—eleven times greater

While the exact figures are not available, differences in height, diameter and volume continued to follow the same trend five years later.

From these and other studies, the following conclusions are drawn:

1. At stand densities of fewer than 1500 slash or loblolly pine stems, diameter growth accelerates rapidly as stand density decreases.
2. If stands of slash or loblolly pine remain too dense, their indicated site index will be much lower than actual site capabilities achieved under generally accepted spacings.
3. Thinning dense stands at an early age will sustain desirable live crown. This accelerates diameter, height and volume growth.

4. In order to yield economic returns, dense stands of pine seedlings must be thinned early to reduce stocking and increase growing space. Without this early thinning, rotations are lengthened to the point of being uneconomical.
5. Loblolly pine responds somewhat better than slash pine when thinned after a long period of suppression.

Crowding Decreases Wildlife Forage

The production of herbaceous plants is reduced significantly by crown closure. One study in central Louisiana showed that when an over-dense slash pine stand was thinned at age three, herbage yields increased remarkably nine years later. When tree basal areas were 125 square feet, herbage yields were 560 pounds per acre. At 54 square feet, herbage yields jumped to 2230 pounds.

The vigor, and the fruit and browse production of woody plants are likewise greatly reduced by overstory competition. In east Texas a comparison was made of fruit production and twig growth of seven browse species grown in the open and beneath a saw-timber-size stand of southern pines. The open-grown plants averaged 32 times more fruit and nearly seven times more twig growth than the plants grown beneath trees. From the time the crowns close until some thinning is carried out is the most barren period in the life of a pine stand, insofar as wildlife food production is concerned.

Almost any degree of thinning in a young overstocked stand is of some benefit to wildlife. Heavy thinning is even better, especially when combined with prescribed winter burning, which can be done about four years after the stand is thinned.

With thinning plus soil disturbance such as disking, chopping or burning on old-field sites there is normally an immediate response from herbaceous vegetation.

Unthinned Loblolly Stand. *This Crossett, Arkansas loblolly stand is 26 years old. When test plots were thinned precommercially at age 7, the stand contained 25,300 pine stems per acre plus 7000 small hardwood stems.*

Thinned Westvaco Loblolly. *This loblolly stand in South Carolina was thinned by drum chopping two years before the photo was taken.*

Most of the native legumes and some of the grasses and composites that respond produce seeds that are used by quail and to some extent by turkeys. Some of the herbaceous plants also are used as forage by deer and turkeys.

On wildland sites, woody plants are normally more numerous than on old-field sites. More complex mixtures of herbaceous and woody plants are usually released by thinning unless site preparation was very intense.

HAND THINNING

Hand thinning usually is either prohibitively expensive or the labor is simply not available. However, on

Thinned Loblolly Stand. *This 26-year-old plot was hand thinned and has had two commercial thinnings since the original machine thinning. All hardwoods were cut from these plots.*

some small tracts it may be the only practical method because of the expense of moving heavy thinning machinery to the tract.

MACHINE THINNING

Machine thinning has been done using a front-mounted V-blade, a rolling drum chopper, and a large rotary mower. The V-blade pushes the severed seedlings and saplings to the side, into and onto the leave strip, doing just enough damage to cause the tractor operator to compensate by leaving too wide a strip. The rolling drum chopper has done an excellent job where the operator could see ahead to leave a strip no wider than one foot. An excellent job has also been accomplished by the giant double-bladed mower but it is a very expensive piece of equipment to operate. Equal results could be obtained by a small but strong rotary and flail type mower when the seedlings are but two or three years old. Where cut and leave strips were of equal width, release was inadequate.

Wake of a Rotary Cutter. *Clump of 2- to 4-inch hardwoods cut by a front-mounted rotary cutter during mechanical thinning.*

Types of Machines

The following machines have potential for precommercially thinning pines and hardwoods. (mention of these machines is for information only and does not constitute endorsement by the task force):

Bush Hog – a conventional rotary mower normally rear mounted on an agricultural tractor, hydraulically or mechanically driven. Capable of continuous operation in stands up to two inches in diameter, 1000-2000 stems per acre, and zero slope. Cutting width: 4 to 8 feet. Manufactured by Bush Hog, P. O. Box 1039, Selma, Ala. 36701. Tel. (205) 872-6261.

Roanoke Robot – a hydraulic rotary cutter which is side mounted on either a skidder or motor grader. It is capable of (restricted) continuous operation on a stand up to three inches in diameter, 2000-3000 stems per acre, and zero slope. Cutting width: 6 feet. Manufactured by Harrington Mfg. Co., Inc., Lewiston, N. C. 27849. Tel. (919) 397-2531.

Hydro-Ax – a front mounted rotary cutter (single blade, hydraulic motor) self propelled unit capable of continuous forward operation in a stand up to three inches in diameter, 3000 stems per acre, and zero slope. Increases in any of the parameters reduces production. Cutting width: 7 feet. Manufactured by National Hydro-Ax, P. O. Box 568, Owatonna, Minnesota 55060 - Tel. (507) 451-8640.

Hydro-Ax Rotary Cutter. *The Hydro-Ax has a cutting width of seven feet. Like the Kershaw Klearway, it is a front mounted rotary cutter.*

Tree Eater – a hydraulic driven flail mower normally mounted on an agricultural type tractor (front side or rear mounted). Capable of continuous operation in a stand up to two inches in diameter, 2000-3000 stems per acre and zero slope. Cutting width: 6 feet. Manufactured by Hawthorn International Corp., Hawthorn House, Rte. 4, Bethelehem, Pa. 18015. Tel. (215) 865-1257.

Klearway – a front mounted rotary cutter (double blade, dual hydraulic motors) totally contained, self propelled unit capable of continuous forward motion in a stand up to three inches in diameter, 3000-4000 stems per acre, and zero slope. Again, any changes in the parameters reduces productivity. Cutting width: 7 and 10 feet. Manufactured by Kershaw Mfg. Co., P. O. Box 9328, Montgomery, Ala. Tel. (205) 263-5581.

Kershaw Rotary Cutter. *The Kershaw Klearway machine with a cutting width of 7 and 10 feet.*

Rome Brush Cutter — a hydraulic rotary cutter which is mounted on the rear of a motor grader and is capable of (restricted) continuous operation on a stand size up to three inches in diameter, 2000-3000 stems per acre and zero slope. The grader has maneuverability limitation in off-highway operations. The rear mount permits 180-degree swing but has restrictions in stand tree height since the cutter head and boom must reach over the leave strip. Manufactured by Rome Industries, Cedartown, Ga. 30125. Tel. (404) 748-4456.

Rolling-Choppers — designed to cut, crush, and shatter materials. The blades will handle both surface and subsurface growth, as penetration of the blades can be increased by the addition of weight. The cutting widths vary from 6-16 feet (single drum), 6-10 feet (tandem), and 15-20 feet (triple drum). Multiple arrangement cuts material more than once with a single pass. Suppliers of choppers include: FLECO, 1375 West Church Street, Jacksonville, Fla. Tel. (904) 356-6304; Marden Mfg. Co., 205 Denton Ave., Auburndale, Fla. 33823. Tel. (813) 967-1111; and Rockland, Inc., East Story Road, Winter Garden, Fla. 32787.

The Hydro-Ax, Klearway and rolling choppers are capable of operating on more difficult terrain (e.g., high stumps, tops) and with larger stems than the other machines mentioned.

OTHER METHODS

Prescribed burning

No doubt, under some conditions prescribed burning is an economical method of precommercial thinning but should be used selectively and with great care. This method of thinning should be confined to those stands having a satisfactory stocking of trees six or more feet in height, with an understory of younger unwanted pine reproduction. A prescribed burn, carried out at the right time of year under optimum conditions, would eliminate the young reproduction without harming the older trees.

Chemicals

Results with chemicals have been highly questionable so far. The use of Tordon, for example, backfired. The larger stems, with better established root systems, picked up more of the chemical than the smaller, less desirable stems. As a result, the best trees died. Needed is a highly selective treatment that will speed the death of the smaller trees and thereby release the taller and faster growing trees for even better growth.

Logging

Logging the seed trees after seedling establishment has produced some reduction in stocking. It is, however, a highly destructive method which leaves large, unstocked openings and patches and ribbons of dense, unthinned reproduction. Its greatest applicability may be in areas which are only slightly overstocked.

Fertilization

Fertilizing dense stands has prospects of both inducing mortality among weaker trees and aiding the stronger trees to assert dominance.

Maki and Davey of N. C. State University have reported that heavy applications of fertilizers in some of their studies appear to have induced mortality. Several cooperators with CRIFF (Cooperative Research in Forest Fertilization coordinated by the University of Florida) have installed tests of this technique, but reductions have not been drastic enough. Union-Camp Corporation (Virginia) reported that after one year their stocking had been reduced from something like 5,000 stems per acre to 4,000 stems per acre, still grossly overstocked.

Fertilization has produced better results for production of wildlife food, however. On three experimental areas in Alabama the addition of basic slag on burned pine plantations and older natural stands produced a ground cover in which quail food plants became dominant and seed production was greatly increased, compared to areas burned only.

COSTS

The costs of precommercial thinning, of course, depends upon tree size and number of stems per acre, hence the importance of thinning as early as possible. The cost is very high in extra-dense stands but the rewards are very high, also, as borne out by studies discussed previously. Take the case of the Crossett loblolly stand, for example, figuring the price of pulpwood at $7 per cord. If the landowner wishes a return of 6 percent compounded on his investment, he could afford to pay $15 per acre for precommercial thinning.

The Cordele study indicates a landowner could pay over $20 per acre for clump thinning of slash pine. Landowners who have hand labor available to selectively thin in the clumps would be able to spend $40 per acre based on the same research results and using the same economic assumptions. However, hand labor is usually prohibitively expensive or not available.

One company thinned 11,900 acres during 1972 at an average per-acre cost of $9.13, using both rolling-choppers and rotary mowers. In Georgia, 900 acres were machine thinned with a D-4 tractor and rolling-drum chopper at actual cost of $4.14 per acre. This included all costs except depreciation charges on the tractor. These figures agree very closely with costs reported by a company in Louisiana.

INSECT AND DISEASE PRECAUTIONS

While losses from insects and diseases following precommercial thinning are not prevalent, some precautions are in order:

(1) The earlier a stand is thinned the greater the likelihood that insect-caused losses can be avoided.

(2) Where insect attacks are likely, particularly during extensive outbreaks, thinning should be restricted to the fall and winter months to coincide with the reduction in insect activity.

(3) In areas of high Fomes annosus incidence, thinning when the mean daily temperatures exceed 70° F. minimizes the danger of spreading the infection.

(4) The greatest potential for spreading Fomes annosus infection occurs when winter thinnings are made on light, sandy soils formerly in agriculture production. Poorly drained and heavy clay soils are low hazard sites for infection spread.

RECOMMENDATIONS

- If slash or loblolly stand contains more than 1500 stems per acre, thin precommercially at age two to five. At this age, stems are easily severed and tractor operator can see ahead easily. Thinning at early age also minimizes risk of Ips beetle attack and infection with Fomes annosus.
- Machine thin young stands with rotary mower or tractor-drawn rotary mower depending upon density of stand, if terrain is free of high stumps and slash material.
- If stems are five feet and taller and have average diameter of no more than three inches in a dense stand use heavy-duty drum choppers or equipment with front-mounted blades. Jackstrawing of stems can be avoided by adding metal arms on sides of bumper to gather stems and channel them under the tractor.
- Strive for 8- to 10-foot lanes. This produces access for fire protection equipment, firebreaks, and provides sunlit areas for production of wildlife forage. Cut wider lanes at intervals to accommodate rolling type fire equipment.
- Keep leave strips as narrow as possible, depending on stocking goal. Actually, the most successful treatments give immediate impression of a decimated stand.
- If sawlog production is the goal, thin in checkerboard strips, leaving small patches of pine trees on 8- to 10- foot centers. If hand labor is available, consider reducing the patches to single trees.
- If very dense stands average more than three inches in diameter, it is probably too late to thin precommercially. When stems reach merchantable size and crown ratios of the dominants are less than 30 percent, clearcut and regenerate. (Keep in mind, however, that loblolly can respond to release better than slash after being suppressed.) If crown ratios are more than 30 percent, it may be possible to thin commercially.
- If wildlife propagation is a landowner objective, prescribe burn as soon as the thinning debris has deteriorated and frequently thereafter. This reduces woody browse plant growth and stimulates seed germination and growth of valuable herbaceous plants for wildlife.

Appreciation is extended to the following field units assisting the task force: Westvaco Corporation, Georgetown and Charleston, S.C.; International Paper Company, Homerville, Ga.; Georgia-Pacific Corporation, Crossett, Ark.; T. L. James & Company, Alexandria, La.; Southeastern Forest Experiment Station, Cordele, Ga. and Southern Forest Experiment Station, Alexandria, La.

FUTURE PRECAUTIONS

So far, discussion has been directed toward coping with the problem of dense stands of nonmerchantable trees. That's the immediate problem, but what of the future? Here are suggestions on how to avoid the problem in the first place:

Use row seeding when direct seeding, where possible, to help control stocking. Strive for 1000 to 1500 seedlings per acre. Use no more than one-half pound of slash or loblolly seed per acre. On well prepared sites, use one-quarter pound. Keep site preparation to minimum needed, depending on nature of site.

Do not overly prepare site for natural regeneration, and harvest overstory no later than three years after seedlings have been established. (Logging will do little damage when seedlings are this age, also.) Subsequent seedfall will continue to compound the density problem.

If in spite of these precautions too many seedlings are established, thin at the earliest age possible to 500-700 seedlings per acre. Thinning is more economical now than at any other point in time!

Include provisions for a permanent or semi-permanent network of access roads and fire lanes in regeneration plans. Here again, this is far more economical than cutting swaths later.

Remember that most of the precommercial thinning done to date can be characterized as "too little, too late."

Suggested Reading

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